

ORIGIN OF ANIMAL SPECIES

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At the beginning of this century I had already rejected the theories of organic evolution expounded by Charles Darwin and his successors, because they obviously explained nothing, and were contradicted by facts. I was convinced that these theories were so far out of line that they could not be corrected by modification, and that the right answer must lie along fundamentally different lines.

For many years I studied the problem — not in the hope of solving it, but because I could not banish it from my mind. It was in 1914 that the thought occurred to me that the species might not be descended from pre-existing species, but that each species might be descended directly from protozoa. My wife, Mabel Crawley Gilbert, was so impressed with this idea that she began a diligent study of human embryogenesis from this point of view. She soon discovered and pointed out to me that the development of the human individual lends itself with the greatest alacrity to a literal phylogenetic interpretation; and, further, that the human organism, throughout the early stages of development, is so organized as to be capable of a free, extra-uterine existence — if due allowance be made for cenogenetic fetal modifications. There can be no doubt that the human embryo was originally free-living, and that it became parasitic within the uterus at a later stage in the history of the species. And there can be no doubt that our earliest ancestors, barring fetal adaptations, passed through the same developmental steps, in the same order, and perhaps in the same interval of time, as the modern individual. Thus the distinction between ontogenesis and phylogenesis vanishes. They are identical, and may be merged in the same word—*somatogenesis*.

If this be true of the human species, it is presumably true of all species. This can only mean that each species must be directly derived from a unicellular substratum. It means that the classical conception of "blood-relationship" and "common ancestors" must be abandoned. There are no common ancestors among metazoic species.

After further study Mabel Gilbert recognized larval and pupal stages in human ontogenesis, and correlated them with ancestral stages of sex development. The human chorion, after thousands of generations in the uterus, bears little resemblance to a larva. But the chorions of cattle and swine are still distinctly grub-like in form. The back of the early human embryo arches concavely. But as the organism enters the pupal state (fourth to fifth week) the back begins to arch convexly, and the embryo assumes a curled-up posture, with chin on breast, characteristic of the sleeping animal. The synchronous closing and sealing of the eyelids can scarcely be dismissed as a coincidence. Reopening of the eyes at a later stage indicates, of course, emergence from the pupal condition. (For a detailed account of human sexual development and its correlation with metamorphoses, the reader is referred to pages 18 to 28 in our pamphlet *Origin of Metazoa By Glacial Integration*.)

Upon these bases, which I have never doubted are entirely correct, we built a tentative theory of organic evolution. However, we were not satisfied with it because it failed to explain certain important angles of the problem — e. g., the sudden outburst of new species following world revolutions. We eventually came to the conclusion that glaciation must be a factor of prime importance in evolutionary development. However, it seems that we rather overestimated the importance of this factor, for an intensive examination of the paleontological record reveals

that new species have occasionally appeared in the entire absence of glacial conditions.

Mabel Gilbert died in 1923. Some years after her death the theory of *Glacial Integration* began to take shape in my mind, and I felt that I was on the right track. This assurance was strengthened when I at length succeeded in explaining glaciation to my own entire satisfaction. (The reader is referred to my article in Vol. LXXVI, No. 5, of the *Pan-American Geologist*, or to the section under the subtitle "The Cause of Glaciation" in our pamphlet *Origin of Metazoa By Glacial Integration*.) I was thus able to explain not only the appearance of new species after each world-revolution, and the inter-revolutionary stasis, but also the wholesale destruction of marine forms during glacial epochs, which is a salient feature of the paleontological record.

The theory of *Glacial Integration* provides that cells of the vegetative cycles of solitary marine protozoa, which ordinarily separate and disperse, were caused to cohere as a mechanical effect of the hypertonicity of sea water during glacial times. The coherent mass of cells thus produced was elaborated into a body by differentiation and regimentation of the cells.

In the year 1940 I wrote the manuscript which was later published under the title *Origin of Metazoa By Glacial Integration*. I delayed publication of this manuscript for three years, because it seemed not to fit the picture with the required degree of precision. However, I could not discover what was wrong with it and, in the year 1943, with some misgivings, I published it. I had mailed out a few hundred copies when a thought occurred to me that enabled me to put my finger on the difficulty. It was this: If ontogeny is a chronologically accurate account of phylogeny, it is certain that sex differentiation of metazoa began *after* integration, since the early human embryo is sexless. But sex phenomena are already universal among protozoa. Hence metazoa could not have arisen by the integration of protozoa. The logic is irrefutable. Metazoa are not descended from protozoa.

I immediately rejected the theory of *Glacial Integration* as untenable. But I still retained the basic conceptions — which, indeed, I have never doubted — namely, that ontogeny and phylogeny are identical, and that each species is directly derived from unicellular ancestors.

I was thus confronted with this problem: Metazoic somas originated by the integration of cells, but the integrated cells were not protozoa. What, then, were they? Several considerations presented themselves:

1. Protozoa, like metazoa, are divided into distinct species.
2. Protozoa exercise all the physiological functions exercised by metazoa. The organellae of the former correspond to the organs of the latter. An adult protozoon, therefore, must be regarded as a *unicellular soma*, corresponding to the *multicellular soma* of metazoa.
3. Sex was evidently developed independently by protozoa and metazoa. Many of the protozoa produce unequal gametes, corresponding precisely to the ova and spermatozoa of metazoa.

From these considerations the conclusion seems unavoidable that both protozoa and metazoa are derived from a primitive type of cell in which sex had not yet developed. I have elsewhere suggested the word *Protocyte* to denote the primitive, minute, sexless cell from which both protozoa and metazoa were

derived. In the case of metazoa the protocytes were integrated to form a multicellular soma. In protozoa there was no integration, and the ancestral protocyte developed into unicellular soma. If each protozoic species, like the metazoic species, is derived directly and independently from protocytes, it follows that among protozoic species, as among metazoic, there is no "blood-relationship" and no "common ancestors." The attempt to derive divergent protozoic types from a "common ancestral stock" is based upon fallacy, and cannot succeed.

The question at once arises, is there any phenomenal evidence to substantiate these hypothetical "protocytes"? The answer is *yes*. There is embryological evidence that such cells actually existed, and that they were the original ancestors of living species of protozoa and metazoa. Rather, they were the *original reproductive cells*, from which individuals of the first generation arose.

Having long been firmly convinced that every step in ontogenesis, however obscure and cryptic, must carry a definite and literal phylogenetic significance, I had often wondered what might be the meaning of the transformation of the spermatid into a spermatozoon. I was sure that this phenomenon must afford a clue to some important phase of phylogeny. The answer now became clear to me. The spermatid is the modern representative of the ancestral protocyte. The transformation of spermatid into spermatozoon means that the ancestral human protocyte originated as an amebula, and developed into a flagellula by the acquisition of an axial filament.

If protozoic species also were derived from protocytes, something equivalent to the spermatid — the ontogenetic representative of the ancestral protocyte — should appear in the life cycles of protozoa. And, indeed, it does. The agametes of foramenifera precisely fulfill this requirement. The protozoic agamete is comparable to the metazoic spermatid; the microgamete is comparable to the spermatozoon. Many of the Sporozoa probably repeat the development of their original ancestors from the protocyte *literally* in the development of the adult individual from the sexless agamete.

The theory of *Glacial Integration* provided that the somas of metazoa were designed and constructed by protozoa, and that the profound physiological and biochemical knowledge that enabled protozoa to construct these intricate and admirably adapted mechanisms was acquired by didactic interaction with environment over long periods of time. But, for reasons set forth above, this assumption is not tenable. Protozoa did not construct the multicellular somas of metazoa. A metazoon is not a colonial protozoon. Both the multicellular somas of metazoa and the unicellular somas of protozoa must have been designed by a pre-existing agency. This agency must have been the repository of the skill and knowledge that the theory of *Glacial Integration* wrongly attributed to protozoa, or "germplasm."

I had for some time suspected that there is in existence a different and higher form of life than anything we know. This suspicion now began to crystallize in the conception of a *Being* of chromatinic organization which has inhabited the ocean—probably the Pacific—continuously since the beginning of geological time. It is the physical seat of the profound knowledge and transcendental intellect that designed and created the varied multitudes of living things that have marched in the pageant of organic evolution. It is the source and author of all earthly life. The germplasm of the species are fragments of its substance; the sentient consciousness of living things is a reflection of its effulgence. I have elsewhere referred to it as *The Central Chromatinic Body*, or *Archesome*.

It was with reluctance that I introduced this conception into the evolutionary scheme. However, it is unavoidable, since the facts demand it. In constructing the theories herein presented, I have been guided solely by *facts*, and not at all by opinions or beliefs, even though they happened to be my own.

It is obvious that each species is admirably adapted to its own way of life. Therefore we cannot escape the conclusion that each species was *designed in advance* to fit a specific environmental facet. The genetic system of each species was allotted to it by the *Central Body*, and has been reproduced *unchanged* from generation to generation throughout the ages. This conclusion leads to others which are equally inescapable, namely:

1. *Something* must have designed the somas of the species.
2. Whatever agency designed these somas must have had an intimate knowledge of environmental conditions.
3. The creation of a soma by means of chromatinic determinants requires a degree of skill, knowledge, and intelligence that is far beyond our comprehension.

Knowledge and intelligence, so far as we know, cannot exist apart from the appropriate mechanism of living matter. Knowledge and intelligence can be acquired only by experience with physical events and their consequences. Transcendental intelligence should be associated with a higher form of physical life. Hence my conception of a *Central Chromatinic Body*, educated by millions of centuries of didactic interaction with environment.

These considerations, though cogent, would scarcely have induced me to announce such a fantastic conception. But other considerations led me to a conclusion which seems to justify it — namely, that *evolutionary trends are initiated and guided by logical reasoning and forethought*. The manner in which I arrived at this conclusion is as follows:

A striking feature of the paleontological record is the outburst of new species following world-revolutions. This phenomenon demands an explanation. It was explained very satisfactorily by *Glacial Integration*, but the explanation was wrong. What, then, is the correct explanation?

World-revolutions are rude and violent interruptions to the serenity of environmental conditions. They introduce new and unforeseen hazards to the survival of existing life. They suggest modifications and improvements in existing somatic patterns, designed to meet temporary or permanent changes in environment. New and improved species are the *Central Body's* answer to vicissitudes of world-revolutions. In some instances the precise nature of the environmental exigency and the specific answer of the *Central Body* can be readily recognized.

The paleontological record shows that, roughly speaking, *marine* forms appeared in the Paleozoic era, *cold-blooded* land animals in the Mesozoic, and *warm-blooded* animals in the Cenozoic. We see here the operation of a mentality akin to ours. The first experiment in body-building — the marine forms of the Paleozoic — was unsuccessful. These organisms were almost entirely destroyed by lethal marine conditions that prevailed during the Permo-Carboniferous ice

age. The *Central Body's* answer to this world-wide catastrophe was the construction of the land reptiles of the Mesozoic. However, these animals were cold-blooded, and perished in the severe refrigeration that closed the era. The *Central Body*, therefore, devised the warm-blooded animals of the Cenozoic to survive sub-freezing temperatures. What clearer evidence of logical reasoning and forethought could be desired?

There was an ice age of considerable magnitude at the close of the Silurian period, during which there must have been an extensive destruction of marine life. We see, accordingly, the first experiment in an *amphibious* soma in the Devonian, followed by a development of these forms in the Carboniferous. The characteristic caution of the *Central Body* is thus illustrated in the production of an *intermediate* form before producing a land animal.

The primitive Paleozoic fishes were driven by a slowly expanding surface stratum of scalding water out of the oceans into the rivers, where they perished in such numbers as to lead paleontologists to the (erroneous) conclusion that they were native to fresh water. The *Central Body* subsequently produced the Teleosts, which were *designed* to inhabit fresh water.

Other examples could be cited. If the paleontological record were carefully evaluated, it would doubtless prove to be an amazing epic of the triumph of transcendent ingenuity over mundane vicissitudes. With such spectacular evidence to support it, my conception seems to need no apology.

At the time of its origin in Archaean time the *Central Body* knew nothing about the construction of living things, and nothing about world environment beyond its own submarine habitat. Its education in body-building was acquired during geological time by the trial-and-error method — by experiment, correction, and improvement. Hence we see the evolutionary procession led by forms of elementary simplicity, followed by an ever increasing complexity of organization as time rolled on through the eras, and the knowledge, skill, and experience of the *Central Body* enlarged. The evolution of living things is the visible expression of the didactic development of chromatin within the *Central Body*.

From time to time during the history of the earth, and particularly following world revolutions, groups of protocytes were budded off from the *Central Body*. Each group gave rise to a single species. Thus each species arose as a separate act of creation by the *Central Body*.

The gemmation of protocytes by the *Central Body* probably began late in Archaean time. Each group of protocytes was equipped with the genetic system of a single species. The genetic system of a species determines the development of those functional and morphological characters that distinguish the species. It is, in effect, a *blue-print* of the soma, and is reproduced from generation to generation *unchanged*. The soma of a species is stereotyped — immutably fixed for all time within the restricted limits of artificial breeds and geographical varieties. The genetic system of each species was preformed within the *Central Body*. The development of a species is determined entirely by its genetic system, and is unaffected by environmental factors. Each species was designed *in advance* by the *Central Body* to suit a special environmental facet. An adverse change in environment with which the stereotyped soma is unable to cope results only in extinction of the species.

The earliest protocytes produced by the *Central Body* developed into protozoa. We thus find evidence of unicellular life in the Archaen rocks. The integration

of protocytes to produce metazoic somas occurred in the basal Paleozoic and, accordingly, we find the Cambrian seas swarming with simple invertebrate life. I no longer believe that integration was an effect of glaciation, or of any other environmental factor. Integration is a basic behavior pattern of the physical universe.

The earliest metazoic somas of the Paleozoic era were evidently patterned upon existing protozoic types. Thus we see the radially symmetrical soma (Porifera, Coelenterata, Echinodermata), and the bilaterally symmetrical soma (flatworms, annelids, molluscs, arthropods, chordates), patterned respectively upon radially and bilaterally symmetrical protozoa. And we see stalked, sedentary, floating, and swimming somas patterned upon protozoa of like habit. In early Paleozoic time the *Central Body* was experimenting with various types of somas, and eventually hit upon the chordate type as the most satisfactory model. However, the *Central Body* was not restricted by taxonomic considerations, and frequently combined in the same soma features distinctive of different phyla, as in *Ornithorhynchus*, *Archeopteryx*, *Eoornis*, etc. Hence, also, we have taxonomic "lumber yards" — Mesozoa, Nematomorpha, Molluscoidea, etc.—which include organisms difficult or impossible to classify under the phylogenetic schemes of "blood-relationship."

Throughout geological time the somas have become increasingly intricate and complex. But the evolution of higher forms was slow and cautious. Each new species was an elaboration or modification of the original phyletic pattern—a slight improvement upon existing species. Hence the animal kingdom falls into phyletic series, within which there are no sharp breaks, no abrupt changes. This condition, together with the existence of so-called "intermediate forms," appears at first glance to favor the principle of "blood-relationship." But this principle has condemned itself by leading to a hopeless search for non-existent "common ancestors" and to the equally hopeless attempt to find an invertebrate "ancestor" for the chordates.

The *Central Body* has evidently been striving to fill every nook and cranny of the earth's habitable regions with a suitable form of life. Successful types of somas were elaborated, improved, specialized. Unsuccessful types — e. g., the giant reptiles of the Mesozoic — were discontinued. The *Central Body* groped its way into environment by putting forth exploring pseudopodia in the form of species. And this leads to the inevitable conclusion that the *Central Body*, from its lair in the ocean, is sentient to the tips of its far-flung tentacles. Sentient consciousness is indissolubly associated with life. The consciousness of each individual organism is a fragment of that of the *Central Body*.

Within the same phylum the most divergent types are merely modifications of the same basic pattern. Differences between species in the same phylum are due to the elaboration or suppression of characters common to them all. Those structures that are suppressed are the so-called "vestigial" structures. The whale has vestigial legs. Does that mean that the early ancestors of whales were terrestrial? I used to think so, but now I realize that the idea is naive. The whale has rudimentary legs merely because it is a mammal, and mammalian specifications call for legs — because the earliest mammals were terrestrial. Man has a "vestigial" appendix. Does that mean that the appendix was functional in our remote ancestors and has become reduced to a rudiment by disuse? Not at all. The vermiform appendix is a basic feature of mammalian anatomy. It has been

suppressed in Man and the carnivora because they were not designed to subsist on vegetation.

The origin of species is a difficult, but soluble, problem. If the theories offered herein are correct, individuals of the first generation of metazoic species developed from protocytes by a process of cell multiplication, differentiation, and regimentation differing in no essential respect from modern somatogenesis. The protocyte, therefore, was the original spermatid, and differed from the modern spermatid only in being derived from the *Central Body* instead of from a germinal epithelium. The first generation of protozoic species developed directly from protocytes by a process which differed in no essential respect from the development of a modern Sporozoon from an agamete. The ancestral protocytes of protozoic species, therefore, differed from modern agametes only in being derived from the *Central Body* instead of by multiple fission of a gamont. The protocytes, therefore, were the original reproductive cells. More logically, they might be called *productive cells*. Spermatids and agametes are reproductive cells.

The problem of the origin of *Life* is probably beyond the range of human mentality. For in the equation of life there is an unknown quantity which we call *consciousness*. This cannot be explained as a product of physical forces. Nevertheless I have no doubt that the phenomenon of life is a typical feature in the secular cooling of planets like the earth, and that the production of such planets is a typical feature in the life of stars. (The reader is referred to my article in Vol. L, No. 2, of *Popular Astronomy*.)

The ancestral protocytes of *Homo sapiens* were budded off in the ocean from the *Central Body* in late Pleistocene time. They were equipped at the outset with all the germinal potentialities of twentieth-century mankind. The course of their development was determined by their chromatinic content. The human body was carefully designed in advance to cope with world environment, and was not subject to environmental influence or control except to the limited extent permitted by somatic plasticity, which has found expression in geographic variation — the races of mankind.

The protocytes probably entered immediately upon a vegetative cycle in which the original number of individuals was multiplied by fission. During this vegetative cycle the protocytes developed from amebulae, resembling spermatids, into flagellulae, resembling spermatozoa. Integration then occurred, by the substitution of segmentation for fission, producing a multitude of minute clusters of undifferentiated cells. These cell clusters are identifiable with the "morula" stage of modern embryogenesis. The cell clusters proceeded to develop into human bodies by a process of multiplication, differentiation, and organization identical with modern somatogenesis — except for the absence of fetal adaptations, which arose at a later stage in the history of our species, when the uterus became functional. The developing cell clusters were *embryonic human beings*, differing from the modern embryo only in being free-living instead of parasitic within the uterus.

After passing rapidly through blastula and gastrula stages, the cell clusters began to take on the form of marine chordates, 3 mm. or 4 mm. in length, and comparable in organization to modern embryos of the same size. The original gastrulation is identifiable with the growth of the blastoderm to enclose the yolk-

mass. The yolk sac is thus the larval gut, and is comparable to the archenteron of *Amphioxus*. As in the modern embryo, the first structures to appear were aquatic. As in the modern embryo, these structures no sooner appeared than they were dismantled and remodeled into structures adapted to terrestrial life. At the same time the anlagen of lungs and limbs, organs of terrestrial respiration and locomotion, made their appearance.

Did our original ancestors acquire gill slits because they inhabited the ocean? Did they develop terrestrial structures because they emerged from water onto land? I think the answer to both questions is No. The human embryo acquires gill slits because gill slits are a basic feature of the chordate pattern. The earliest chordates were marine. It remodels the gill slits and develops lungs and limbs because it was designed to be a land animal. Mammalian specifications call for lungs and limbs. The development of the human soma was predetermined, and was not influenced by environment. Nevertheless, I believe on other grounds that our first ancestors originated in the sea, and that they left the sea *instinctively* at a very early stage of somatogenesis.

The developing cell clusters were carried far and wide by ocean currents. Some of them were carried north through Behring Strait, and landed on the northern coast of Asia. Traces of ancient man reveal that others must have landed on the shores of Africa, Australia, and eastern Asia.

In the modern embryo the "milk line" arises early in uterine life. Originally these ridges were probably organs of locomotion resembling in operation the gastral foot of land snails. In embryos of 8 mm. the milk ridges extend from the axillar to the inguinal regions. The limbs point caudad. The parotid glands open into the mouth cavity. The eyes are situated at the temples. Ancestral conditions were precisely similar. At the time of their emergence our original ancestors were segmented, snail-like organisms a few millimeters in length. Locomotion was accomplished by longitudinal waves of the ventral ridges. The nascent limbs, being as yet useless, were trailed along. The face was applied to the ground. Mucus was secreted by the parotid and submaxillary glands, and by the glands of the ventral ridges, so that the organism left a trail of slime behind as it glided over the rocks of the seashore at low tide. Our ancestors at this stage were *asexual*, reproducing first by fission (as in *Hydra*), later by budding (as in *Cephalodiscus*).

In human embryos of about 18 mm. the limbs are constricted into three segments and are bent ventrad, at right angles to the body-axis. The elbows and knees turn outward and slightly caudad. This is the position assumed in walking on all fours. At the same time the eyes swing around toward the front of the face, and the median nasal processes fuse with each other and with the maxillary processes, giving the face, for the first time, a distinctly human appearance. At the same stage of somatogenesis the limbs of our original ancestors became functional, raising the face and the ventral surface of the body off the ground. In other words, they stopped crawling on their bellies and arose on all fours. The face, upon being removed from the ground, underwent a remodelling, and the eyes shifted ventrad, enabling the organism to look down at the ground. The original use for the milk line ended when our ancestors arose on all fours. Shortly afterward glands of the milk line were converted into mammary glands by sex hormones, and the rest of the structure atrophied. Our ancestors at this stage were about two centimeters long. They were clumsy, slow moving, with a short, blunt tail. They were *hermaphrodites*.

Thus our first multicellular ancestors, originating in the ocean as clusters of undifferentiated cells, passed through the same developmental stages, in the same order, and probably in a comparable interval of time, as modern individuals. By the time they had attained a size and degree of organization comparable to that of a modern fetus of seven or eight months, they had become unilateral hermaphrodites, laying self- or cross-fertilized eggs. Due to the introduction of the second maturation division, these eggs eventually hatched into males and females. The hermaphrodites developed no further sexually, but probably continued to grow until they reached the size of a modern human adult. No doubt they continued throughout their lives to lay eggs and to walk on all fours. The hermaphrodites eventually died out, and hermaphroditism became merely a transitory stage in the ontogenesis of males and females. Among social insects the ancestral hermaphrodite has been preserved and modified as a worker.

Individuals of the first generation of men and women were comparable in size and development to the modern fetus of eight or nine lunar months. The historical attainment of bisexuality (racial puberty) is marked in the modern embryo by descent of the testes, a sudden acceleration in uterine growth, and the activity of the mammae in the secretion of "witch milk." These phenomena occur near the close of uterine life. The uterus and mammary glands became functional in the first generation of women. The original period of gestation was four weeks. The individual was born a larva, and pupated soon after birth. After remaining in the pupal state for six or seven months, the individual emerged as a mature man or woman. The first men and women thus reached puberty at the zygotic age of about nine months, and were comparable in size and organization to the modern fetus at term. They no doubt continued to grow, reaching in due time the stature of a modern adult. But their mentality remained throughout life comparable to that of a new born babe.

During the generations which have elapsed since the first dioecious generation there have been several important changes:

1. The period of gestation has lengthened from four weeks to nine months. The original period persists as the menstrual flow. Originally only the larval stage was passed in the uterus. Now both larval and pupal stages are passed in the uterus.

2. The attainment of puberty has been delayed from the ninth lunar month to the twelfth to sixteenth year after birth. This interval is the *nymphal stage*, which has been interposed between racial and individual puberty.

3. With the slow expansion of the nymphal period there has been a commensurate development of mentality. Adult men and women of the first dioecious generation were in the mental grade of new born babes. Individuals of later generations advanced, as the nymphal phase expanded, through grades of mentality characteristic of toddlers, young children, older children, adolescents. The modern individual repeats ancestral mental development exactly during the nymphal period. The hormones of puberty bring mental *maturity* and arrestation of mental development.

We are now able to understand the triumph of *Homo sapiens* over his human and near-human predecessors. Cerebral development in the individual is arrested by the hormones of puberty. But in our species puberty is delayed by an endocrine mechanism, so that brain and mentality are permitted to develop until the twelfth to sixteenth year. *Homo sapiens* is born an idiot, but he does not remain an idiot.

Pithecanthropus, Neanderthal, Piltdown, Cro-Magnon men were also born idiots, and *remained* idiots throughout their lives, because the glandular mechanism for nymphal expansion had not been perfected. Individuals of these species therefore reached puberty at a very early age. These men of low intelligence were unable to compete with men of the modern type, and were rapidly extinguished. It is probable that the Cro-magnon men were born with as good brains as Homo sapiens. But they had no *childhood*, which is the essential condition for cerebral development.

Toward the close of uterine life the legs of the modern fetus undergo a torsion about their long axes through a right angle, so that the toes point forward. At the same time the intestines fall from the umbilical to the pelvic region. The curves of the spine undergo a modification. At the same stage of somatogenesis

— i. e., in the first dioecious generation — our ancestors learned to stand erect and walk on the hind limbs. The viscera, of course, sagged by gravity.

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